ROYAL BOTANIC GARDENS, KEW.

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LIX.—PHYTOCHEMICAL INVESTIGATIONS AT KEW.

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In August, 1909, I had the privilege of examining phytochemically in the Jodrell laboratory at Kew a number of plants cultivated in the celebrated Royal Botanic Gardens.

During this examination I received generous help from the Kew scientific staff; my indebtedness to them is here gratefully acknowledged.

In this report I wish to give a brief survey of my results; at present only a part can be published, as it was found necessary to examine further many plants at another season of the year. I hope to do this in 1910, and then to bring together the additional results in a second report.

At Kew there was a unique opportunity, not only of supplementing and checking previous observations made in my own laboratory at Haarlem, but especially of investigating chemically plants which had not been analysed hitherto, and thus of collecting new data for pharmacology, toxicology, and in a wider sense, for *comparative phytochemistry*, *i.e.* the knowledge of the connection between the natural relationship of plants and their chemical composition. For many years I have paid attention to comparative phytochemistry and was connected from 1888–92 with the Botanic Gardens at Buitenzorg (Java). The subject has always attracted me, and considerations connected with it have influenced me both in the laboratory and in theoretical study. Perhaps I may therefore be permitted once more briefly to point out what is the task of the chemist in a botanic garden, and especially what is the relation between his chemical work and botanical science, especially systematic botany.

Since plants are no longer classified according to a single character (*i.e.* according to an artificial system), but attempts are made to unite into natural groups such plants as are considered to

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be related, the systematic botanist desires to know that relationship in *all* its manifestations.

Not only are the structures of the flower and of other organs of the plant carefully compared in the different groups, but the history of the development of those structures is traced. In addition the anatomical characters revealed by the microscope have been successfully utilised to throw light on the relationships of plants, and in this way it has not infrequently been possible to define an order, genus, or species much more sharply than would be possible by organographic characters alone. Some investigators have rightly attempted to elaborate this anatomical investigation by applying microchemical tests for constituents such as alkaloids, glucosides (*e.g.* saponin), hydrocyanic acid, etc., which are typical of certain groups of plants. In this manner, therefore, chemistry has already come to the assistance of the botanist. Often, however, the result of this botanical microchemistry is unsatisfactory because many plant constituents have first to be isolated from the tissue and purified, before they can be recognised with certainty, and for this isolation the botanist not infrequently lacks the experience and critical knowledge of the chemist.

Chemistry, then, can only give complete assistance to systematic botany, when it is used not incidentally, as a botanical aid, but when opportunity is offered in botanical surroundings for the independent prosecution of the subject, *i.e.* for the chemical study of the general and special constituents of the plant. That this study of phytochemistry, apart from its own scientifie value and its close connection with systematic botany, is also of practical importance, may be briefly shown.

The vegetable kingdom supplies us with food and clothes and satisfies many of the numerous material wants of modern life; moreover, a not inconsiderable proportion of drugs are still derived from plants. There is no other way of ascertaining whether new plants of economic value, including medicinal plants, which are introduced from foreign countries, deserve general attention, than by subjecting them to analyis, by performing their chemical evaluation. This applies not only to medicinal, but to all other technical plants, and also to plants which are reported to be food-stuffs or poisons. It therefore appears clear that chemistry and botany should co-operate in the study of the plant world; yet it is a matter for surprise that this co-operation is so rarely brought into practice. There are whole natural orders of which we know nothing chemically, of which not a single representative has been analysed, so that our knowledge concerning their "virtues" is limited to popular belief and popular experience, a source of knowledge naturally good, but often obscured by superstition.

Strictly speaking one might demand that every accurate description of a new genus or of a new species should be accompanied by a short "chemical description" of the plant. Instead of working in this direction, and seeking the aid of chemists, some systematic botanists now neglect in their diagnoses even that which might give at least a preliminary chemical insight of the plant, such as details of smell and taste, and accounts of popular applications as food, drug or poison. The older botanists carefully

summarised such details, but among the later ones there are some who neglect all this, and who are not even concerned with the popular names of their plants. They invert the adage "*non scholae sed vitae*" and are not concerned with the utility of their writings outside their own circle of botanical colleagues.

It will be asked, however, is it impossible for botany and chemistry to pursue their objects separately? Yes. It is necessary that the chemical investigations should *begin* in the botanic gardens themselves, because it is only there that one can decide experimentally:—1. What part of the plant is best suited for analysis and also in what part of the vegetative period the active principle is most abundantly present. 2. Whether constituents occur in the fresh plant which disappear on drying. 3. What is the exact name and nature of the plant under investigation and what are its nearest relations, or in what other species and genera does the same chemical constituent occur. We may further suppose that in questions of microscopical technique, of plant physiology, cultivation, &c., chemistry will be consulted more readily and to better advantage if it is found side by side with botany. I consider it a special disadvantage that the chemist who examines plants or parts of plants without botanical guidance and far from a botanical centre, so easily remains uncertain as to the true name and nature of his material. What is indeed the use of examining a root or a bark or any other material under a false name (which afterwards leads to confusion) or of analysing material of which the botanical origin is not known? Such work resembles that of mediæval monks and cannot be utilised in comparative phytochemistry.

It has just been remarked that the chemical investigation of plants must *begin* in a botanic garden. When the elementary data concerning the presence or absence of special plant subtances in a given genus or species have once been obtained, the continuation, *i.e.* the complete chemical study (including that of the constitution) of plant substances on the one hand, and their toxicological and pharmacological investigation on the other, can take place in the laboratories proper to these sciences. First, however, there must be a phytochemical basis. In a second report I hope to give a scheme by which, in my experience, the preliminary phytochemical examination may best be conducted in a botanic garden (assuming that it contains a simple laboratory) in such a way that no important plant substance may escape attention, and yet that simple resources and a comparatively small amount of chemical labour may suffice.

As an introduction to this first report, I now only wish to add a few remarks on those plants and plant constituents which more especially engaged my attention during my work at Kew. With respect to the choice of plants from that large collection I have been chiefly influenced by considerations of comparative phytochemistry. In addition, I wished especially to examine genera of which I had already previously obtained material either at Buitenzorg or at Haarlem. As regards the plant substances with which this preliminary examination was chiefly concerned, I paid most attention to the distribution of tannins and of alkaloids, and further looked especially for

hydrocyanic acid and for saponin (two substances, the taxonomic value of which has already been referred to). This choice of plant substances may be defended as follows :—

Tannin.—While it was formerly assumed, simply on account of the black coloration with iron salts, that tannins are present in almost all plants, Dr. J. Dekker has shown by his investigations at Haarlem, that real tannins are comparatively rare and that there are whole natural orders which do not contain any tannin. The reaction with ferric chloride by itself is valueless as evidence ; only when it is confirmed by the reaction with a quinine solution and with a gelatin solution, is it possible to consider the presence of tannin established. It is therefore desirable to collect new and reliable data concerning the distribution of tannins in various natural orders, as was done experimentally by Dr. Dekker during the preparation of his monograph (which appeared as Bulletin Nos. 35 and 39 of the Colonial Museum at Haarlem) ; I have not neglected the unique opportunity at Kew of working on the same lines. A knowledge of tannins is very useful with regard to medicinal and technical plants and is also important in comparative phytochemistry.

Alkaloids. – Our knowledge concerning the distribution of alkaloids in various natural orders is already fairly complete, because we are here concerned with crystalline, well-defined substances of special medical or toxicological value, which are often characterised by a bitter taste or poisonous properties and which, for nearly a century, have been diligently searched for by the pharmacists of the whole world. Nevertheless, there are here also lacunae in our knowledge, and it was my object at Kew to attempt to fill these in some cases. Careful attention was therefore paid to the taste of the plants under investigation and the decoction of every plant was tested for alkaloids by means of three reliable reagents : a solution of picric acid, a solution of iodine, and Mayer's reagent (potassium mercuric iodide solution). If these tests gave a positive result, some material was, if possible, dried carefully for isolation and examination of the alkaloid.

Hydrocyanic acid.—In the last two decades the occurrence of hydrocyanic or prussic acid (HCN) as a widespread constituent of plants has received so much attention, and has led in England, especially in the laboratory of the Imperial Institute, to such important chemical work, that it will be clear why the author of this report during his investigation paid attention to this substance. Its presence frequently throws a remarkable light on the fatal toxic effects on man and animals often ascribed to certain plants and occasionally revealed by them quite unexpectedly. It becomes evident from this first report that a number of new cyanogenetic plants have been discovered by me at Kew ; I have also tried to delimit the known centres of the distribution of prussic acid. This is now done more readily than formerly, because the distillate of the plant is not required in the first instance for the detection of hydrocyanic acid ; but as a preliminary test, the simple and elegant reaction with picric acid-soda paper, which was described in 1906 by Prof. L. Guignard, of Paris, may now be utilised. Quite a number of additions have already to be made

to the list of hydrocyanic acid plants, which was communicated by me with explanatory details to the meeting of the British Association at York, in 1906. I hope to append this list, brought up to date and arranged according to natural orders, to my second report.

Saponin.—Of still greater pharmacological and toxicological importance than the occurrence of hydrocyanic acid in a given plant, is the discovery in it of a poisonous glucoside of the saponin group. A number of medicinal, toxic and economic properties of the plant may thus suddenly become clear. Medicinally: its use as diuretic, antisyphilitic (*e.g.*, *Sarsaparilla*), expectorant (*e.g.*, *Senega*), emetic, vermifuge, taenicide, &c. Toxicologically: various poisonous actions on man and on animals, ascribed to the plant by popular experience, and further, the important application of saponin-containing plants as fish poisons and as insecticides. Economically: the use in washing as a substitute for soap (*e.g.*, *Quillaja*). For further information I refer to the excellent work of Prof. R. Kobert, "Beiträge zur Kenntniss der Saponinsubstanzen," 1904. Unfortunately in the case of saponins there are no well-defined chemical characteristics like those of hydrocyanic acid, but for practical purposes three properties suffice: in the first place, the marked frothing of a plant extract containing saponins, which persists at very great dilutions (sometimes to 1 in 3,000, occasionally even to 1 in 15,000); secondly, the hydrolysis of glucosidal saponins by boiling with dilute acids and the colour reactions of the sapogenin formed; thirdly, as an important indication of the general toxicity, the determination of the haemolytic power. In the following report, the figures 1–300 mean, for instance, that an extract of the plant at a concentration of 1 part in 300 dissolves an equal volume of diluted (1 per cent.) fresh blood of the ox.

I now append a list, in alphabetical order, of the genera (according to the nomenclature of the *Index Kewensis*), of those plants with which positive results were obtained during my investigation at Kew, supplemented as far as possible by earlier or later results at Haarlem. Of course I also noted negative results for my own information, but in the examination of plants these are markedly less definite than positive ones, because the season of the year, the age and vitality of the plant, &c. may have much influence. I hope to refer further to some results in the second report. For this journal I have purposely formulated the results as briefly as possible, in a few lines, but have added some details concerning the plant itself; its systematic relationship and the medicinal and other properties ascribed to it*. I hope that I have thus rendered the report somewhat more readable and interesting, and have made

* The medicinal notes have mostly been taken from the great work of the late Prof. G. Dragendorff: Die Heilpflanzen der verschiedenen Völker und Zeiten; ihre Anwendung, wesentliche Bestandtheile und Geschichte, 1898. For the toxicological notes I have especially used my "Monographie der giftige en bedwelmende planten bij de vischvangst in gebruik" (Monograph on fish poisons) which is at the same time a survey of the most poisonous plants of the world, and their distribution in natural orders. Of this work vol. I. was published in 1893 at Batavia and vol. II. in 1900; vol. III. will be ready for the press in 1910.

clear by these examples what was said above about the utility of phytochemical investigation in botanic gardens.

Abelia (Caprifoliaceae).

The leaves of *A. uniflora*, R. Br., contain saponin.

Acacia (Leguminosae-Mimoseae).

At Kew I found saponin in the leaves of *A. pulchella*, R. Br.; according to notes made at Haarlem saponin also occurs in the seeds of *A. verticillata*, Willd.

Various other species (such as *A. anthelmintica*, Baill., *A. Cunninghamii*, Hook., *A. concinna*, DC., *A. delibrata*, A. Cunn.), were already known to contain saponin. Six species of *Acacia* are mentioned as fish poisons in my "Monographie der bedwelmende planten bij de vischvangst in gebruik," Vol. II., p. 69; this is probably connected with the presence of saponins.

Alectryon (Sapindaceae).

The leaves of *A. excelsum*, Gaertn., were found to contain much hydrocyanic acid.

The fruits of the species examined, a New Zealand tree, are said to be edible, and the seeds are said to contain oil.

In 1897, at Buitenzorg, van Romburgh found hydrocyanic acid in a species of *Cupania*, belonging to this order; in addition *Schleichera*, has already been known for a long time to contain hydrocyanic acid.

Amarantus (Amarantaceae).

The leaves of *A. hypochondriacus*, L., give an extract which froths strongly and indeed contains saponin. This result was confirmed by examining the seeds of *A. hypochondriacus*, L., and *A. melancholicus*, L. (= *A. gangeticus*, L.), which also contain a little saponin. Amarantus-saponin is only slightly toxic, giving but feeble haemolysis.

Amarantus was not yet known to contain saponin, but saponin was recently recorded for *Achyranthes bidentata*, Bl. This substance is doubtless also present in other species and the use of some species as an anthelmintic in popular medicine, *e.g.*, that of *A. viridis*, L., is connected with this.

Anacyclus (Compositae).

At Kew I found hydrocyanic acid (and benzaldehyde) in the seeds of *A. officinarum*, Hayne, and at Haarlem in those of *A. pedunculatus*, Pers.

Compare for the distribution of HCN in this order the note on *Dimorphotheca*.

Andrachne (Euphorbiaceae).

The leaves of *A. colchica*, Fisch. et Mey., are characterised by a marked toxicity, which according to my analysis depends on the presence of hydrocyanic acid. I could also detect the odour of benzaldehyde, but had too little material for further investigation.

For a long time the genus *Andrachne* has been known to be poisonous; the amount of hydrocyanic acid found affords an explanation of this, and also of Watt's statement that the foliage of *A. cordifolia*, Muell. Arg., has caused cattle poisoning in British India. Possibly the powerful antiseptic action of hydrocyanic

acid is the reason why an extract of *A. Cadishaco*, Roxb. (= *Cleistanthus collinus*, Benth. et Hook.), is used for washing ulcers.

Anthemis (Compositae).

For more than a year the investigation of this genus has been carried on in my laboratory at Haarlem, and I utilised my stay at Kew in order to extend it to some new species. In summarising the results hitherto obtained, it may be said that the seeds of the following contain much HCN : *A. aetnensis*, Schouw, *A. altissima*, L., *A. arvensis*, L., *A. austriaca*, Jacq., *A. Blancheana*, Boiss., *A. chia*, L., *A. Cota*, L., *A. elbuensis ?* *A. montana*, L., *A. rigescens*, Willd. In all cases I determined the amount of hydrocyanic acid quantitatively ; it is largest in *A. Blancheana*, namely 0·15 per cent., and diminishes in other species to 0·03 per cent. It is remarkable that the cyanogenetic substance is limited to the seeds ; we have never found it in the foliage. Most of the above-mentioned species have been cultivated in the laboratory garden at Haarlem, but unsuccessfully as regards the discovery of hydrocyanic acid outside the seeds. The seeds were mostly presented by the Jardin des Plantes at Paris. From a large quantity of seeds of *A. aetnensis*, and *A. chia*, obtained from the firm of Haage and Schmidt of Erfurt, I have prepared the cyanogenetic glucoside. It belongs to the amygdalin type, giving off hydrogen cyanide and benzaldehyde on hydrolysis. The strong odour of benzaldehyde may even be observed on grinding the seeds with water.

Anthemis contains *i.a.* the parent plant of " Roman Camomile " (*A. nobilis*, L.) of which the ethereal oil has frequently been examined. Apart from this little is known as to the activity of the genus. *A. Cotula*, L., is sometimes called in English " Poison Daisy." Compare the note under *Dimorphotheca* concerning hydrocyanic acid in *Compositae*.

Aphanopetalum (Saxifragaceae).

The leaves of *A. resinosum*, Endl., have a very bitter taste. The extract froths slightly and shows alkaloidal reaction. I was able to extract the alkaloid from a small quantity of leaves by shaking with ether. The plant deserves further examination.

Arrhenatherum (Gramineae).

The grass *A. avenaceum*, Beauv., yields an extract which froths strongly and contains saponin ; this is confirmed by the investigation at Haarlem, of the seed of *A. elatius*, Beauv., which is indeed identical with this species according to the *Index Kewensis*. An extract of the seed froths at 1–1000 but haemolyses only at 1–100.

Astragalus (Leguminosae-Papilionaceae).

The plant of *A. maximus*, Willd., contains much saponin, the same is true of the seeds of *A. baeticus*, L., *A. galegiformis*, L., and *A. hamosus*, L.

A number of species of *Astragalus* have been recorded as poisonous to cattle ; some are counted in America among the notorious loco-weeds. Saponin had not yet been found in this genus but alkaloids were known. The root of the species examined, *A. hamosus*, L., is known as a diuretic (Dragendorff, l.c. p. 323).

Atriplex (Chenopodiaceae).

At Kew, I examined two species of this genus, viz., *A. Halimus*, L., and *A. Nuttalii*, S. Wats., and found saponin in the leaves of both, especially in the last-named species. At Haarlem, I had at my disposal seeds of *A. hortensis*, L., *A. laciniata*, L., *A. rosea*, L., *A. tatarica*, L. and *A. vesicaria*, Hew., and found much saponin in all; the haemolysis by an extract of the seeds is moderately great, 1–250 to 1–750.

Atriplex is new as a saponin plant; in the same order only *Chenopodium mexicanum*, Moq., was known to contain saponin. We may remember, for instance, that the foliage of *A. hortensis*, L., is used as a diuretic, the seed as an emetic, which is quite plausible on account of the saponin-content. In China, a skin disease occurs "atriplicismus" caused by a poisonous species of *Atriplex*?

Buddleia (Loganiaceae).

The leaves of *B. globosa*, Hope, contain saponin. Seeds of *B. Lindleyana*, Fort., examined at Haarlem, gave an extract containing saponin, which frothed at a dilution of 1–500 and haemolysed at 1–800. There is also a little saponin in the seeds of *B. variabilis*, Hemsl. It is known that the leaves of *B. madagascariensis*, Lam., are used as a soap substitute, the twigs of *B. brasiliensis*, Jacq., *B. curviflora*, Hook. et Arn., and *B. verticillata*, H.B. et K., as a fish poison and other species as taenifuge or vermifuge, and also as diuretic and expectorant.

Callicoma (Saxifragaceae).

The leaves of *C. serratifolia*, Andr., contain saponin, but not in large quantity.

Calophyllum (Guttiferae).

The leaves of *C. Calaba*, Jacq., contain saponin. Poisonous properties are not unknown in this genus; some *e.g.*, *C. Inophyllum*, L., and *C. montanum*, Vieill., are used as fish poisons.

Canella (Canellaceae).

Canella and *Cinnamodendron* are the only genera of this small order.

It is of some pharmaceutical interest that *C. alba*, Murr. (Engler and Prantl refer to *C. alba* under the name *Winterana Canella*, L.), the plant from which white cinnamon is obtained, contains much hydrocyanic acid, also that this acid does not occur in the drug. An investigation of some fresh leaves which I had at my disposal at Kew, proved this with certainty. The leaves further contain a volatile oil and an acrid resin which causes a burning sensation on the tongue. It would be interesting to examine also the seeds of these plants for the cyanogenetic principle, but the material for this is not obtainable in Europe. The statement of A. Stahl (1884) thus becomes clear, according to which in Porto Rico, twigs of *C. alba*, Murr., are thrown on the water to narcotise fish in order that they may be easily caught.

Cassia (Leguminosae-Caesalpineae).

The leaves and also the seeds of *C. marylandica*, L., contain saponin; an extract froths at 1–500 and causes haemolysis at 1–125. In *Cassia* there are a number of data which point to the presence of saponin (*e.g.*, the employment of some as fish poison, of others as

insecticide, vermifuge, &c.) but the experimental proof is wanting in most cases. There is also a *C. venenifera*, Rodsch. (= *C. hirsuta*, L.), which still remains to be examined.

Castanospermum (Leguminosae-Papilionaceae).

The leaves of *C. australe*, A. Cunn. et Fraser, contain saponin, readily recognised by the strong frothing of an extract; I could not detect any saponin in the seeds.

The seed is edible but rather indigestible. Observations in Australia had already shown that the leaves are harmful to cattle. The saw-dust from the wood of *Castanospermum* greatly irritates the mucous membranes (saponin!). The roasted seeds are eaten as "Australian chestnuts."

Ceanothus (Rhamnaceae).

In the laboratory at Kew, I examined the leaves of four species, viz., *C. azureus*, Desf., *C. integerrimus*, Hook. et Arn., *C. thyrsiflorus*, Eschw., and *C. velutinus*, Dougl. They all contain saponin, most of all the two last mentioned. The young leaves, especially of the first two species, have an aromatic odour, owing to the presence of methyl salicylate; the leaves of *C. integerrimus* gave a mucilaginous extract. Saponin is also present in small quantity in the seeds of *C. americanus*, L., and *C. ovatus*, Desf.

Various species are used medicinally in America; thus the bark is used as a febrifuge. The root of *C. americanus*, L., is an antisyphilitic. In the species *C. reclinatus*, L'Hérit. (= *Rhamnus venosa*, Lam.), L'Hérit. earlier investigators found an alkaloid.

Cercis (Leguminosae-Caesalpineae).

The leaves of *C. canadensis*, L., and *C. chinensis*, Bunge, yielded tannin and saponin.

In the literature it is only mentioned that the leaves and seeds of the Judas tree (*C. Siliquastrum*, L.), which are free from saponin, serve as an astringent, and that the bark of *C. canadensis*, L., is employed against diarrhœa. According to Engler and Prantl, the acrid leaves of *C. Siliquastrum*, L., are eaten as salad and the buds as capers.

Cercocarpus (Rosaceae).

The leaves of *C. parvifolius*, Nutt., were found to contain much hydrocyanic acid.

No species of this genus (all from Mexico and California) had previously been investigated in a laboratory. They must undoubtedly be henceforth reckoned among poisonous plants.

Choisya (Rutaceae).

The aromatic bitter leaves of *C. ternata*, H.B. et K., deserve closer chemical investigation, for they contain an alkaloid, a volatile oil, and a little saponin. The crystalline alkaloid can be set free by caustic soda and can then be extracted with ether.

Chrysosplenium (Saxifragaceae).

The foliage of *C. oppositifolium*, L., contains a little saponin. *C. alternifolium*, L., is considered poisonous to sheep.

Cinnamomum (Lauraceae).

It may here be noted that the fresh leaves of *C. Tamala*, Nees, were found at Kew to contain much camphor; like many *Lauraceae* they contained much mucilage, and they yield a frothing extract.

The presence of camphor in a few other *Cinnamomum* species besides the real camphor tree (*C. Camphora*, Nees), has already been observed, *e.g.* in *C. Parthenoxylon*, Meissn.

Clematis (Ranunculaceae).

At Kew there is a rich collection of this genus, and I was able to detect hydrocyanic acid in *C. Fremonti*, Wats., *C. integrifolia*, L., *C. lanuginosa*, Lindl. et Paxt., *C. orientalis*, L., *C. pseudoflammula*, Schmalh. (In the next report I hope to give quantitative determinations of the hydrocyanic acid content, made in another season than that of my visit in August, 1909.) The presence of HCN in *C. recta*, L., is still somewhat doubtful; the leaf of this plant contains much methyl salicylate.

Saponin is of widespread occurrence in this genus; I found it in the leaves of *C. aethusiaefolia*, Turcz., *C. Bergeroni*, Lavall., *C. Buchaniana*, DC., *C. calycina*, Ait. (=*C. cirrhosa*, L.), *C. Flammula*, L., *C. Fortunei*, T. Moore (=*C. Williamsii*, A. Gray), *C. Fremonti*, Wats. (together with HCN), *C. Hendersonii*, Hort. (=*C. reticulata*, Walt.), *C. grata*, Wall., *C. integrifolia*, L., *C. lanuginosa*, Lindl. et Paxt. (together with HCN), *C. orientalis*, L. (together with HCN), *C. Pitcheri*, Torr. et Gray, *C. recta*, L. (*see* above), *C. Vitalba*, L., and *C. Viticella*, L. It may further be remarked that the leaves of *Clematis* are blackened in water, evidently owing to a strong ferment action on the tyrosine present.

The leaves of almost all the species are known as acrid and poisonous. In the genus *Ranunculus*, HCN was first observed by Fitschy in 1906, and in *Thalictrum* by van Itallie in 1905.

Cobaea (Polemoniaceae).

The leaves of the well-known ornamental plant *C. scandens*, Cav., were found to contain much saponin ; an extract of the seeds froths only at 1–400 and haemolyses at 1–200.

Combretum (Combretaceae).

The leaf of *C. bracteosum*, Brandis, contains some saponin. The genus contains several colonial medicinal plants. The young leaves of *C. racemosum*, Beauv., and the fruit of *C. trifoliatum*, Vent., are used as an anthelmintic; the seed of *C. phaneropetalum*, Bak., is also used as a taenifuge, but in large doses it is toxic. The fruit of *C. erythrophyllum*, Sond., is known to be poisonous. The species examined is called in South Africa " Hiccup nut " because when eaten it causes persistent hiccup.

Cormus (Rosaceae).

The small ornamental shrub *C. foliolosa*, Franch., in Kew Gardens develops a strong odour of oil of bitter almonds on merely rubbing the leaves, and afterwards hydrocyanic acid and benzaldehyde were demonstrated with certainty.

Cormus is placed in the division *Sorbus* of the genus *Pyrus*. The plant may be said to be cyanogenetic " par droit de naissance."

Cortaderia (Gramineae).

The grasses *C. conspicua* (*Arundo conspicua* Forst.), and *C. Kermesiana*, (a variety of *C. argentea*), are very poisonous on account of a high content of hydrocyanic acid ; they are moreover avoided by cattle on account of their hardness.

In 1906 Fitschy found hydrocyanic acid in the well-known Pampas Grass *C. argentea*, Stapf (*Gynerium argenteum*, Nees), an observation which I have confirmed. There is no indication that the true *Gynerium*, H. et B. contains hydrocyanic acid. Of late years a number of grasses have been found, some in my own laboratory, which are poisonous owing to the presence of HCN. *See* the summary under *Stipa*.

Cortusa (Primulaceae).

The leaf of *C. Matthioli*, L., contains saponin, which is of general occurrence in this order. Popular medicine prescribes this species for lithiasis, ischias, &c.

Cucumis (Cucurbitaceae).

The foliage of *C. metuliferus*, E. Mey., gives a strongly frothing extract and contains saponin. I also found this substance in the seeds of *C. dipsaceus*, Ehrenb., and *C. Sacleuxii*, Hort.

The seed of cucumbers and pumpkins is much sought after as a remedy against tape-worm and oxyurus. Perhaps this depends on the saponin which I also found in the seeds of *Lagenaria vulgaris*, Ser., and *Cucurbita maxima*, Duchesne.

Cystopteris (Filices-Polypodiaceae).

The foliage of *C. alpina*, Desv., *C. bulbifera*, Bernh., and *C. fragilis*, Bernh., contains a glucoside which yields on hydrolysis hydrocyanic acid and benzaldehyde. The odour of oil of bitter almonds is especially intense in the young leaves of *C. fragilis*, Bernh. ; there is also a trace of HCN in the spores.

Probably the odour of this fern has been noticed before, and this is the reason why *C. fragilis*, is mentioned as a popular remedy (Dragendorff, l.c. p. 56). While I was investigating *Cystopteris*, in the Jodrell laboratory I received a postcard from H. Woynar, of Graz, who wrote to me in connection with my publication on transitory hydrocyanic acid in *Pteris aquilina*, L., and some other ferns as follows : " Vielleicht interessirt die Mitteilung, dass alpine *Cystopteris*-arten, namentlich *C. montana*, Bernh., den intensivsten Blausäure-geruch zeigen, Rhizom und Blatt. Ich beobachtete dies in den Nord-Tiroler Alpen, sowohl in den nördlichen Kalkalpen (Lias) als auch im Schiefergebirge auf altem zum Dyas gehörigem Kalk (Dolomit)."

Davallia (Filices-Polypodiaceae).

The fern leaves of *D. brasiliensis*, Hk., *D. elegans*, Sw., *D. hirta*, Kaulf., *D. majuscula*, Lowe, *D. pentaphylla*, Bl., and *D. strigosa*, Sw., examined by me at Kew, were found to be distinctly cyanogenetic. The intensely bitter taste is remarkable, especially in the young foliage of *D. pentaphylla*, Bl. The most abundant formation of HCN was in the form cultivated as "*elegantissima*" and in *D. strigosa*, Sw., in which the formation of benzaldehyde was also observed. In the foliage of some other species HCN could not be detected ; *D. heterophylla*, Sm., and *D. marginalis*, Bak. (= *Microlepia marginata*, C. Chr.), give a frothing extract, *D. rhomboidea*, Wall. (= *Microlepia trapeziformis*, Kuhn), a mucilaginous one. The spores of *D. trichosticha*, Hk., and *D. platyphylla*, Don (= *Microlepia platyphylla*, J. Sm.), also give clear

indications of saponin : the extract frothed a good deal and had an acrid taste.

Davallia is an addition to the as yet small number of cyanogenetic ferns which have become known since my discovery of HCN in *Pteris aquilina*, L., in 1908. Notes on *Davallia* as drug or poison are rare ; the foliage of *D. trifoliata*, Sw., is regarded as a diuretic and expectorant and is used in the West Indies in lung disease.

Deutzia (Saxifragaceae).

The leaf of *D. staminea*, R. Br., yields a bitter extract which froths strongly and contains saponin. In *D. corymbosa*, R. Br. (= *C. parviflora*, Bunge), and *D. Vilmorinae*, Lemoine et Bois, the leaf only contains tannin. The discovery of saponin in this genus is confirmed by the investigation of the leaves of *D. gracilis*, Sieb., and *D. setchuenensis*, Franch., which also proved to contain saponin. In the seeds of *Deutzia*, no saponin was found.

Although it is a well-known genus of ornamental shrubs, no species of *Deutzia* had as yet been submitted to analysis.

Deyeuxia (Gramineae).

The grass *D. Langsdorffii*, Kunth, contains saponin. A systematic investigation of the distribution of saponin in Grasses would be worth while ; according to numerous laboratory notes which I made at Haarlem this substance seems to be of rather wide-spread occurrence in the leaves of grasses.

The roots of *D. Halleriana*, Vasey, are considered a diuretic.

Diervilla (Caprifoliaceae).

The leaves of *D. japonica*, DC., contain saponin ; the seeds not. The plant under examination has long been recorded as poisonous. In N. America the stem of *D. trifida*, Moench., is used in the same way as Sarsaparilla.

Dimorphotheca (Compositae).

D. Ecklonis, DC., contains much hydrocyanic acid. In the leaf of this plant and in the seed of *D. pluvialis*, Moench., I found much saponin.

This genus was first recognised as cyanogenetic by Couperot in 1908 ; he examined *D. pluvialis*, Moench., in the leaves of which I too found HCN at Kew, both in the plants cultivated under that name and in the variety *D. hybrida*, DC. At present the following *Compositae* are known to contain hydrocyanic acid : *Anacyclus*, *Anthemis*, *Aplotaxis*, *Centaurea*, *Chardinia*, *Cirsium*, *Cladanthus*, *Dimorphotheca*, *Pyrethrum*, *Xeranthemum*.

Dionaea (Droseraceae).

In a few leaves of the celebrated little plant *D. muscipula*, L., I was able to demonstrate hydrocyanic acid with certainty, even with Guignard's test. Further investigation is pretty well excluded, on account of the rarity of the material in Europe.

Dionaea shows its relationship to *Drosera* also chemically. Hitherto laboratory observations on *Dionaea* only referred to the "eating" of insects by this plant. From the Palmengarten at Frankfurt a-M., I received material of another rare Droseracea, namely *Drosophyllum lusitanicum*, Link. This plant was also found to contain appreciable quantities of hydrocyanic acid.

Dirca (Thymelaeaceae).

The leaf of *D. palustris*, L., contains saponin. The species in question has for a long time been suspected; the acridity of its taste was noted as equal to that of *Daphne*; the plant is described as an emetic and narcotic.

Discaria (Rhamnaceae).

The leaf of *D. serratifolia*, Benth. et Hook., contains much saponin. On account of the supposed remedial action in fever an American species has been called *D. febrifuga*, Mart. The allied plant *Colletia spinosa*, Lam., is said to contain saponin.

Drimys (Magnoliaceae).

In May, 1909, I found that the leaves, and especially the flowers of *D. Winteri*, Forst., received from the University Botanic Gardens at Leiden, contained hydrocyanic acid. Afterwards I was able to confirm this with material from the gardens at Amsterdam, and at Kew. In the latter gardens I also had at my disposal a small branch of *D. aromatica*, F. Muell., it contained considerably more HCN than the first-mentioned species. The leaves of both species of *Drimys*, have an exceedingly acrid taste and cause a burning sensation on the tongue, the extract (especially of *D. aromatica*), froths strongly and contains much tannin. The odour of the ethereal oil resembles that of fennel and of cinnamon.

It is the source of the long known "Cortex Winteranus."

Drosera (Droseraceae).

The leaf of *D. binata*, Labill., attracted my notice at Kew, on account of its acrid bitter taste. On investigation, a fairly considerable quantity of hydrocyanic acid was found to be present, but the amount of material was not sufficient to determine the form of combination of the liberated HCN. *D. rotundifolia*, L., and *D. intermedia*, Hayne, were also found to contain a little HCN.

In the case of *Drosera*, popular observation has once more preceded experimental investigation, for several species (*D. communis*, St. Hil., *D. filiformis*, Raf., *D. peltata*, Sm., *D. stolonifera*, Endl.), are regarded as toxic and harmful to cattle. Thus *D. communis*, St. Hil., is known to be fatal to sheep, and the same is surmised in the case of *D. peltata*, Sm. Further investigation will be necessary in order to decide whether a special acrid principle is present in addition to the cyanogenetic one. The well-known *D. rotundifolia*, L., was formerly used in popular medicine in various countries and was again recommended some years ago as an excellent remedy for bronchitis, asthma, cough and whooping cough. Compare C. Hartwich: Die neuen Arzneidrogen aus dem Pflanzenreiche, 1897.

Erythronium (Liliaceae).

In the leaves of *E. purpurascens*, S. Wats., I found at Kew, saponin. I afterwards obtained at Haarlem, from the well-known nurseries of van Tubergen, fresh bulbs of the following ornamental plants: *E. Dens-canis*, L., *E. giganteum*, Lindl. (= *E. grandiflorum*, Pursh.), *E. revolutum*, Bak. (= *E. purpurascens*, S. Wats.). The extracts froth strongly but are only slightly poisonous judging by the feeble haemolysis.

The bulb of *E. Dens-canis*, L., is used as an anthelmintic, *E. americanum*, Ker-Gawl., is considered an emetic and expectorant. All these applications undoubtedly depend on the saponin content. According to Engler and Prantl the boiled bulbs of *E. americanum*, L., are eaten in North America.

Eurotia (Chenopodiaceae).

In the leaves of *E. ceratoides*, Mey., I found saponin. In this order saponin appears to occur very generally.

Exacum (Gentianaceae).

The leaves of *E. affine*, Balf., contain saponin. I cannot find any application or observation concerning this genus which points to the occurrence of saponin. Doubtless the bitter principles are more prominent here.

Forsythia (Oleaceae).

At Kew, I found a little saponin in the leaves of the hybrid *F. intermedia*, Zabel.; at Haarlem, also a little in the seeds of *F. suspensa*, Vahl.

In 1887, Eykman pointed out that there occurs in the leaf of *F. suspensa*, Vahl, a similar glucoside to that present in *Phillyrea*. This Chinese plant is *i.a.* recorded as a diuretic. Porter Smith says it is considered "slightly poisonous."

Galega (Leguminosae-Papilionaceae).

The leaves of *G. officinalis*, L., var. *alba*, give a strongly frothing extract and contain saponin. I found the same substance in smaller quantities in the seeds of *G. officinalis*, L., and of *G. orientalis*, Lam.; the former gives an extract frothing at 1–1000 and haemolytic at 1–125.

Galega was formerly used in pharmacy, *i.a.* as a diuretic. The genus is closely related to various plants used as fish poisons or known in other ways to be poisonous.

Gilia (Polemoniaceae).

G. aggregata, Spreng., contains saponin; the saponin is very poisonous. At Haarlem I found that an extract of the seeds of *G. laciniata*, Ruiz et Pav., only froths at 1–400, but still haemolyses at 1–800; in the seed of *G. achilleaefolia* these dilutions were 1–900 and 1–1000 (!), for that of *G. nivalis*, 1–200 and 1–500.

Saponin appears to occur generally in this order.

Gleichenia (Filices-Gleicheniaceae).

The foliage of *G. flabellata*, R. Br., is characterised by a high saponin content.

I only find recorded that the rhizome of *G. Hermanni*, R. Br., is used against asthma in Japan, and that of *G. dichotoma*, Hook., in Mauritius.

Halimodendron (Leguminosae-Papilionaceae).

In the leaves of *H. argenteum*, Fisch., a high saponin content was observed.

Heptapleurum (Araliaceae).

I found saponin in the leaf of *H. emarginatum*, Seem. Many saponin plants are found in this order. In 1897 at Buitenzorg, Plugge found saponin in *H. ellipticum*, Seem. (=*H. venulosum*,

Seem.), and in *H. scandens*, Hiern; according to further investigations of Boorsma (1902) this saponin is but slightly toxic. The leaf of *H. rigidum*, Seem., is used *i.a.* as a diuretic. Saponin is known in various other *Araliaceae* (*Aralia*, *Panax*, *Polyscias*, *Trevesia*).

Hydrangea (Saxifragaceae).

In *Hydrangea* there is a clear example of "transitory hydrocyanic acid," such as I have also demonstrated in ferns. In 1908 and 1909 I sometimes found considerable quantities of hydrocyanic acid in the well-known ornamental plant, *H. Hortensia*, Sieb., and sometimes I did not. Probably the cyanogenetic principle disappears from the leaves in autumn; in any case the young leaves contain much more HCN than the older ones. In adult leaves of *H. Lindleyana*, which is considered a variety of *H. Hortensia*, Sieb., and in *H. Thunbergii*, Sieb., the content may amount to 0·04 per cent. and the odour of benzaldehyde is observable on hydrolysis. At Kew I carefully examined eight species of *Hydrangea* but only found HCN in one of these (*H. Thunbergii*, above mentioned). I found that the hydrolysis of the glucoside takes place very slowly; apparently the leaves contain but little enzyme. The very sweet taste of this leaf is remarkable. Apart from the species mentioned I once found hydrocyanic acid in the foliage of *H. involucrata*, Sieb.; the Guignard reaction, repeated with other material of the same species, was however negative; the extract frothed strongly.

Hydrocyanic acid had not yet been found in this genus; in the bark of *H. arborescens*, L., saponin was discovered in 1887.

Isopyrum (Ranunculaceae).

A small quantity of seed obtained from a plant of *I. fumarioides*, L., grown at Kew was found to contain a little hydrocyanic acid. The investigation should be continued.

Isopyrum is related to cyanogenetic genera.

Jamesia (Saxifragaceae).

The leaves and stems of *J. americana*, Torr. et Gray, contain an appreciable amount of hydrocyanic acid. The liberation of HCN in the leaf, bruised with water, only took place very slowly; probably the leaf contains but little enzyme.

No details are known concerning the applications of this species —the only one of the genus—a shrub of the Rocky Mountains.

Kageneckia (Rosaceae).

The leaves of *K. angustifolia*, D.Don, when bruised with water, freely develop hydrocyanic acid and benzaldehyde, they must therefore contain a cyanogenetic glucoside of the amygdalin type, but the *extremely bitter* taste, which cannot be caused by amygdalin, is very remarkable. In Kew a second species of this genus is cultivated, namely *K. oblonga*, Ruiz et Pav., from Chili. According to my analysis this species also contains much hydrocyanic acid, and its taste is also very bitter. This remarkable bitterness has not escaped previous observation, for in Bentham and Hooker, Gen. Plant. I, 614, it is stated explicitly in the description, "Semina *K. oblongae*, amarissima."

There are only three species of this genus, found in Chili and Peru. The leaves of *K. oblonga*, and of *K. lanceolata*, Ruiz et Pav., are used in their native country against fever. As in so many cases this popular usage doubtless depends on the bitter taste of the leaves, and presupposes the presence of quinine; in this case the error might prove fatal.

Knightia (Proteaceae).

The leaf of *K. excelsa*, R. Br., contains saponin and, in addition, much tannin.

Kochia (Chenopodiaceae).

The leaf of *K. scoparia*, Schrad., contains saponin, as do the seeds of this species and of *K. arenaria*, Roth. The seeds of *K. trichophylla*, Hort., yielded an extract which frothed up to a dilution of 1–700 and caused complete haemolysis at 1–250. *Kochia* is now a much esteemed ornamental plant known as "Summer cypress." The species examined is used to some extent as a popular remedy in Southern Europe, *e.g.*, as a diuretic.

Liriodendron (Magnoliaceae).

The leaves of *L. tulipifera*, L., contain small quantities of two special substances: hydrocyanic acid and saponin. Both are also present in the rare Chinese Tulip tree, *L. chinense*, Sarg.

It is remarkable that the chemical nature of such a well-known tree had hitherto escaped attention; Lloyd, in 1886, indeed found an alkaloid (?) in the bark, and there are some vague indications of the toxicity of *L. tulipifera*, L. Various parts are used as a drug.

Lonicera (Caprifoliaceae).

It can easily be shown that saponin is widely distributed in this genus. Partly at Haarlem, and partly at Kew, I found it in the leaves of *L. japonica*, Thunb., *L. Ledebourii*, Eschsch. (= *L. involucrata*, Banks)—an extract froths at 1–2000,—*L. Morrowi*, Gray (= *L. chrysantha*, Turcz.), *L. Standishii*, Hook., *L. tatarica*, L., *L. tomentella*, Hook. et Thoms., *L. Xylosteum*, L. The haemolytic power of *Lonicera* saponin is slight. The commonest species, *L. Caprifolium*, L., contains but little saponin in its leaves and none in the berries

Compare in this report: *Abelia*, *Diervilla*, *Symphoricarpus*.

Lucuma (Sapotaceae).

At Kew, I was able to examine two leaves of the species *L. deliciosa*, Planch., and *L. mammosa*, Gaertn. Both yielded hydrocyanic acid, the latter the larger quantity. Benzaldehyde is also formed in the hydrolysis of the glucoside. At Haarlem, I detected hydrocyanic acid in the seeds of *L. multiflora*, A. DC., from Porto Rico.

Lucuma forms a well-known genus of West Indian fruit trees. In *L. Bonplandia*, H.B. et K., Altamirans demonstrated amygdalin as early as 1876, and in other species a cyanogenetic glucoside was suspected, but the experimental proof was wanting. This proof has now been supplied for *L. mammosa*, Gaertn., in particular, for which plant Peckolt had doubted the formation of benzaldehyde (compare Dragendorff, l.c. p. 519).

Macadamia (Proteaceae).

A well-known Australian plant, *M. ternifolia*, F. Muell., the "Queensland Nut," must, according to my analysis at Kew, be considered among the most strongly cyanogenetic plants; in the fresh leaf the HCN content was more than 0·1 per cent.

Our chemical knowledge of this order is still very slight.

Michelia (Magnoliaceae).

The leaf of *M. fuscata*, Bl., has an astringent bitter taste. The bitterness was found to be due to an alkaloid, present in considerable quantity. In the filtered aqueous decoction, the general alkaloidal reagents such as picric acid, iodine and Mayer's reagent, and also mercuric chloride, produce heavy precipitates. I have prepared the alkaloid in the pure state according to the method of Stas-Otto; it is soluble in excess of ammonia.

At Buitenzorg, Eykman found an alkaloid in *M. parvifolia*, Bl., in 1885, and I myself found one in *M. Champaca*, L., in 1890. See Mededeelingen uit 's Lands Plantentuin, xxv., p. 4.

Napoleona (Myrtaceae).

The leaf of *N. Whitfieldii*, Van Houtte, was found to contain saponin.

The genus has been included in *Myrtaceae* and in *Lecythidaceae*; in the latter order saponin is of general occurrence.

Nicodemia (Loganiaceae).

The leaf of *N. diversifolia*, Ten., has a high saponin content. The genus is closely related to *Buddleia*, which has long been known to contain saponin and to be poisonous.

Oldenburgia (Compositae).

The leaf of *O. Arbuscula*, DC., contains saponin in addition to tannin.

Olearia (Compositae).

The herb *O. macrodonta*, Bak., was found to contain saponin. *Olearia* (= *Eurybia*, Cass.) is closely related to *Aster* and to *Erigeron*.

Oxytropis (Leguminosae).

The young leaf, especially of *O. lapponica*, Gaud., has an extremely bitter taste; there is also an indication of saponin. On analysis, the leaf was found to contain hydrocyanic acid. At Haarlem, I found hydrocyanic acid in the seeds of *O. sulphurea*, Fisch. *Oxytropis* is closely related to *Astragalus*. Of the many species but little is known economically. Some (*O. pilosa*, DC., *O. uralensis*, DC.), are used as a popular remedy in their native country. One species, *O. Lambertii*, Pursh., is known as poisonous in Mexico, and there belongs to the ill-famed "loco-weeds." Whether this species also owes part of its toxicity to hydrocyanic acid and part to saponin, has still to be investigated. In California also a poisonous member of this genus is known as "loco-weed."

Paliurus (Rhamnaceae).

If the foliage of *P. australis*, Gaertn. (= *P. aculeatus*, Lam.), is bruised, a strong odour of methyl salicylate may be observed. Among native plants I only know *Monotropa Hypopitys*, L., as containing oil of winter green to the same extent.

Paronychia (Illecebraceae).

P. capitata, Lam., must be considered as containing saponin. The seed of *P. bonariensis*, DC., examined at Haarlem, also contained saponin; the haemolytic power of the extract was 1–100.

Peraphyllum (Rosaceae).

The leaf of *P. ramosissimum*, Nutt., contains a glucoside which in hydrolysis sets free hydrocyanic acid and benzaldehyde.

This species was formerly described as *Amelanchier*; the occurrence of hydrocyanic acid is therefore not surprising.

Philadelphus (Saxifragaceae).

Saponin appears to be distributed in this genus. I found it in the leaves of *P. coronarius*, L., *P. Lemoinei* and *P. microphyllus*, A. Gray; it was, however, absent from the leaves of some other species. I found saponin in the seeds of the following: *P. grandiflorus*, Willd., *P. Lewisii*, Pursh., and *P. tomentosus*, D. Don, which are, moreover, considered in the *Index Kewensis* as synonyms of *P. coronarius*, L. In *P. grandiflorus*, Willd., the saponin content is highest; an extract of the seeds froths at 1–2000 and haemolyses at 1–700.

Phillyrea (Oleaceae).

The leaves of *P. media*, L., contain saponin, but in the seeds only traces are present.

Various species are used as popular remedies in S. Europe, *e.g.*, the leaves as diuretic and as febrifuge.

Phytolacca (Phytolaccaceae).

The leaves of *Phytolacca* species have a noticeably acrid taste and burn the tongue. I found that *P. acinosa*, Roxb., *P. bogotensis*, H. B. et K., and *P. decandra*, L., all contain saponin as the acrid principle. I also examined the seeds and roots of *P. decandra*, L., *P. dioica*, L., *P. Kaempferi*, A. Gray (= *P. acinosa*, Roxb.), and found both organs to contain saponin; although the extracts froth very strongly, the haemolytic power is small, less than 1–100.

Phytolacca is known as a genus of acrid and toxic plants and various popular observations and remedial uses have been recorded with relation to it. Thus *P. decandra*, L., is considered a purgative, emetic, antisyphilitic and taenifuge—all of which is doubtless connected with the saponin content. *P. icosandra*, L., and *P. octandra*, L., are indeed used like soap. From the poisonous root of the Abyssinian species of *Phytolacca* (or of the closely related genus *Pircunia*, Bort.), which is used in its native country against tape-worm, a poisonous saponin had already been prepared. In this species saponin is extraordinarily abundant; I found that an extract of the fruits of *P. abyssinica*, Moq., still frothed at 1–15000, and haemolysed at 1–700. Other toxic principles, insufficiently known, appear, however, also to occur in the genus *Phytolacca*.

Pittosporum (Pittosporaceae).

At Kew I was able to examine various species of this genus. Saponin was found in the leaves of *P. cornifolium*, A. Cunn., *P. crassifolium*, Soland., *P. crioloma*, C. Moore et F. Muell., *P. eugenioides*, A. Cunn., *P. Huttonianum*, Kirk, *P. rhombifolium*, A. Cunn., *P. Tobira*, Ait., *P. undulatum*, Vent. Tannin is also present in these

leaves. The cause of the persistent bitter taste, possessed especially by *P. Buchanani*, Hook., *P. eugenioides*, A. Cunn., *P. rhombifolium*, A. Cunn., and *P. undulatum*, Vent., has not yet been investigated; an alkaloid is only present in traces. *Billardiera longiflora*, Labill., closely allied to *Pittosporum* also contains saponin.

At Haarlem I found saponin a good many years ago in the leaves of *Pittosporum Tobira*, from the University Botanic Garden at Leiden.

The fruits of *P. phillyraeoides*, DC., yielded an extract frothing at 1–4000 and haemolytic at 1–1500. The dry leaf of *P. undulatum*, even gives an extract frothing at 1–1200, with haemolysis at 1–1500.

The fairly common occurrence of saponin in this natural order has already been repeatedly remarked. Some species (*P. coriaceum*, Ait., *P. viridiflorum*, Sims), are even known as soap-substitutes in their native countries. The use of *P. javanicum*, Bl., as a fish-poison doubtless also depends on the high saponin content of this plant. The saponin of *P. undulatum*, Vent., was examined in London in 1904 by Miss Hooper, and the essential oil in 1906 by Power (*Pharm. Journ.* 1904, 588; 1906, 755).

Platanus (Platanaceae).

In the spring of this year (1909) I first observed that the young foliage of the plane-tree undoubtedly contains hydrocyanic acid: I distilled it and converted it into Prussian blue. The quantity is not large and when the leaves grow older the HCN content falls off to small traces. The hydrocyanic acid is not combined with benzaldehyde, but probably with acetone. At Kew I was able to analyse side by side four species of *Platanus* and to confirm all my earlier observations: *P. acerifolia*, Willd. (also regarded as a variety of *P. orientalis*, L.), *P. cuneata*, Willd., *P. occidentalis*, L. and *P. orientalis*, L. In all of these HCN occurs especially in the young leaf; in *P. cuneata*, Willd., the largest amount was found, *i.e.* about 0·05 per cent. Indeed, in the ordinary plane-tree of the London streets (*P. acerifolia*), there is so much hydrocyanic acid present that the amount from every London plane-leaf would be enough to kill a London sparrow.

As far as I am aware *Platanus* was not known to have any other harmful property than that the bristly hairs of the fruit may cause on inhalation the so-called plane-cough.

Polemonium (Polemoniaceae).

At Kew the leaves of *P. reptans*, L., were found to contain saponin. At Haarlem I also examined the seeds of *P. boreale*, Adams, *P. flavum*, Greene, *P. gracile*, Willd., *P. pauciflorum*, S. Wats., and *P. Richardsonii*, R. Grah. (= *P. humile*, Willd.), and found that they all contain saponin, indeed in large quantities; haemolysis with all species at about 1–300.

The genus *Polemonium* has hitherto not been examined chemically, or hardly so. The shoot of *P. caeruleum*, L., is used as antisyphilitic and the root of *P. reptans*, L., as a diuretic.

Potentilla (Rosaceae).

The leaf of *P. davurica*, Nestl. (a variety of *P. fruticosa*, L. ?), a plant from China, cultivated at Kew, is characterised by its pure

and powerful odour of roses. Although the odour of roses (or geraniol) is not particularly rare among plants (the rose-like scent of young Willow foliage is well known and is especially noticeable in *Salix babylonica*, L., and *S. elegantissima*, C. Koch), I know no other plant which has such an intense rose-scent as this Potentilla leaf. In the Jodrell laboratory I prepared from it an "aqua rosarum" of good quality. The leaves of this species of *Potentilla* are said to be used in Russia instead of tea.

Prosopis (Leguminosae-Mimoseae).

The leaf of *P. juliflora*, DC., contains saponin. An extract of the seeds only frothed at 1–200 and haemolysed at 1–125.

The bark of *Enterolobium cyclocarpum*, Griseb., had already been noted as containing saponin. The pods of the species examined are considered poisonous to cattle.

Protea (Proteaceae).

The leaf of *P. cynaroides*, L., bruised with water, sets free a small quantity of hydrocyanic acid. In my second Kew report I hope to give further details about this plant.

The natural order *Proteaceae* is still a "terra incognita" for the chemist. The case of *Macadamia*, mentioned in the present report, is evidently not an isolated one, and there is reason to suspect the presence of hydrocyanic acid in other genera also (*e.g.*, *Brabejum*, *Helicia*).

Psoralea (Leguminosae-Papilionaceae).

I have examined the leaf of *P. macrostachya*, DC., at Kew and the seeds at Haarlem; both contained saponin, especially the leaf.

Many members of this suborder contain saponin. The root of *P. glandulosa*, L., acts as an emetic and the leaves for instance are used as an anthelmintic. *P. tenuiflora*, Pursh., is regarded as poisonous and is avoided by cattle.

Ptelea (Rutaceae).

The leaf of *P. trifoliata*, L., contains saponin but I did not detect any in the seed.

The leaves of the species examined are used in North America as an anthelmintic.

Roupala (Proteaceae).

The leaf of *R. Pohlii*, Meissn., contains saponin; a smaller amount also occurs in that of *R. Verwaineana*, Hort. (a variety of *R. elegans*, Pohl?): in addition leaves of both contain tannin.

Ruscus (Liliaceae).

The foliage, but not the seeds, of *R. aculeatus*, L., must be noted as containing saponin.

The species examined has *i.a.* been regarded as an abortive; in former times, and even now in some countries, it is much in request as a remedy, *e.g.*, as diuretic (and also a substitute for sarsaparilla). The same virtue is ascribed by Arabian physicians to the leaves of *R. Hypoglossum*, L., and *R. Hypophyllum*, L.

Saururus (Saururaceae).

The leaf of *S. lucidus*, Donn (= *S. cernuus*, L.), contains saponin. This natural order is closely related to *Piperaceae* where

saponin has also been found (in *Piper Palmeri*, C. DC.) The root of the species examined is called in North America "black sarsaparilla."

Saxifraga (Saxifragaceae).

None of the twelve species of *Saxifraga* which I examined at Kew contain hydrocyanic acid, but they all contain much tannin. Saponin is present in the leaves of *S. Andrewsii*, Harv., *S. cortusaefolia*, Sieb. et Zucc., *S. cuneifolia*, L., *S. Sibthorpii*, Boiss. A strongly mucilaginous extract is given by *S. Fortunei*, Hook.

But little is known chemically of this genus and the medicinal applications are small. As regards the popular use of some species as lithontriptic we must bear in mind the naïve confusion which transfers the stone-breaking properties from which the genus derives its name, to the "stone" in the human body.

Securinega (Euphorbiaceae).

In a single leaf of *S. ramiflora*, Muell. Arg., I was able to demonstrate hydrocyanic acid by Guignard's reaction. The examination will have to be confirmed and supplemented in India; in Europe sufficient material is not available.

The discovery of hydrocyanic acid in this genus is particularly important, because it promises an explanation of the employment of the bark of the British-Indian species *S. Leucopyrus*, Muell. Arg., as a narcotic fish-poison (Roxburgh) and the use of its leaves as an insecticide (Dymock).

Spiraea (Rosaceae).

The leaf of *S. japonica*, L., contains saponin; that of *S. camtschatica*, Pall., contains much tannin, that of *S. digitata*, Willd., (=*S. palmata*, Pall.), both tannin and saponin. Previously at Haarlem I had already detected saponin in the seeds of *S. Aruncus*, L., *S. bella*, Sims, *S. canescens*, D. Don, *S. Humboldtii*, Hort., *S. laevigata*, L., and *S. palmata*, Pall.

The genus shows a great diversity as regards chemical constituents. Some few species contain hydrocyanic acid; saponin also had already been observed.

Stipa (Gramineae).

As a result of an examination at Kew, the following species can be added to those known to contain hydrocyanic acid: *S. Lessingiana*, Trin. et Rupr. (=*S. pennata*, L.?), and at Haarlem *S. capillata*, L. (according to Dr. O. Stapf a form of *S. gigantea*, Lag.).

The violent toxic action of some species had been known for a long time, but not until 1904 was HCN pointed out as the cause of this toxicity by Hébert and Heim. Various species are now recognised as cyanogenetic belonging to the genera: *Briza*, *Catabrosa*, *Cortaderia*, *Elymus*, *Festuca*, *Glyceria*, *Holcus*, *Lamarckia*, *Melica*, *Panicum*, *Poa*, *Sorghum*, *Stipa* and *Zea*.

Symphoricarpus (Caprifoliaceae).

The leaf of *S. mollis*, Nutt., examined at Kew, was found to contain saponin. At Haarlem I examined the leaves of the ordinary snowberry, *S. racemosus*, Michx., and found that these also contain saponin, but the fruits do not.

The stem of *S. orbiculatus*, Moench., is used in N. America as a diuretic. It is of interest to note that cases of poisoning with *S. racemosus*, Michx., have repeatedly occurred.

Tetragonia (Ficoideae).

The shoots of *T. expansa*, Murr., contain much saponin but not the seeds.

Saponin had previously been found in this order in *Trianthema*. Presumably the saponin of *Tetragonia* is but slightly poisonous, as it is used as a vegetable; in boiling the leaves, the saponin would moreover in general be removed with the water.

Thymus (Labiatae).

In 1905 I pointed out in the Dutch journal "De Levende Natuur" that two varieties of *Thymus Serpyllum*, L., occur in the Dutch sand dunes which can be readily distinguished externally, and which are sharply differentiated phytochemically by the fact that one variety (the common one) forms thymol in its leaves and accordingly smells like this substance, whereas the other always forms citral and consequently has a strong odour of lemons, quite different from the ordinary scent of thyme. At Kew I found *Thymus Serpyllum*, L., var. *album*, in cultivation and noticed that this also forms citral, and not thymol.

Trollius (Ranunculaceae).

The leaves of *T. pumilus*, D. Don, and *T. chinensis*, Bunge (= *T. asiaticus*, L.), contain saponin.

T. europaeus, L., is considered poisonous, and saponin was found in it in my laboratory at Haarlem by Dekker in 1906.

Umbellularia (Lauraceae).

The leaf of *U. californica*, Nutt., was found to be feebly cyanogenetic. If the leaf be rubbed to a pulp with water, an evolution of HCN not only takes place, but one can also observe more readily that the leaf contains an ethereal oil of strong odour, and further that it forms with water a very mucilaginous jelly of an intensely black colour. The leaves are also coloured black on drying.

The species examined is used medicinally in N. America (*cf.* Dragendorff, l.c. p. 244) and according to a recent report (of Chesnut, 1902) also as an insecticide. What insect would be proof against the combined action of hydrocyanic acid, terpene and an alkaloid, to say nothing of the strong oxydase?

Viburnum (Caprifoliaceae).

The leaf of *V. macrophyllum*, Thunb., contains saponin. Some applications of this genus point to saponin being probably widely distributed in it (*cf.* Dragendorff, l.c. p. 641). Thus *V. Opulus*, L., is recorded as an emetic.

Xanthisma (Compositae).

The leaf of *X. texanum*, DC., yields a frothing extract and contains saponin.

Nothing was known regarding the constituents of this genus.

Xylomelum (Proteaceae).

The leaf of *X. pyriforme*, Knight, contains saponin.

LX.—DIAGNOSES AFRICANAE: XXXIII.

1061. **Jasminum Wyliei**, *N.E. Brown* [Oleaceae]; affinis *J. abyssinico*, R. Br., sed paniculis laxis et pedicellis multo longioribus facile distinguitur.

Frutex ramosus, ramis patentibus glabris. *Folia* pinnatim 3-foliolata, glabra, foliolis lateralibus 2·5–3·5 cm. longis 1·6–2·3 cm. latis late ovatis, intermedio 2·5–4·8 cm. longo 2·3–3·6 cm. lato suborbiculari, omnibus breviter acuminatis obtusis vel acutis basi latissime cuneatis glabris. *Paniculae* terminales, subcymosae, 6-7 cm. longae, 8-10 cm. latae, 10–16-florae vel racemi axillares 5–6-flori, laxi, minutissime puberuli. *Bracteae* 2–7 mm. longae, subulatae. *Pedicelli* 7–18 mm. longi. *Calyx* campanulatus, 3 mm. longus, 3 mm. latus, breviter 5–6-dentatus, dentibus 0·3–0·5 mm. longis, minutissime puberulus. *Corolla* 5–6-loba, glabra, alba; tubus 2–2·3 cm. longus, basi 2 mm. diametro, apice 4 mm. diametro, superne gradatim ampliatus; lobi patentes, 1 cm. longi, 5–7 mm. lati, oblongi vel ovati, obtusi.

Natal. Nkandhla, 1220–1520 m., *Wylie in Herb. Wood*, 8860.

1062. **Schizoglossum auriculatum**, *N. E. Brown* [Asclepiadaceae]; affinis *S. parco*, N. E. Br., sed floribus duplo majoribus et coronae loborum appendicibus brevioribus et tenuioribus differt.

Caules 35–45 cm. alti, 1·5 mm. crassi, subcompressi, ancipites, pubescentes vel puberuli, internodiis 5–8 cm. longis. *Folia* erecta, 2·3–4 cm. longa, 1–2 mm. lata, linearia, acuta vel subobtusa, marginibus revolutis, glabra. *Umbellae* ad nodos laterales, sessiles, 3–5-florae. *Pedicelli* 4–8 mm. longi, piloso-pubescentes. *Corolla* fere ad basin 5-loba, intus glabra, extra pilis paucissimis conspersa: lobi 3·5–4 mm. longi, 2–2·5 mm. lati, ovati, acuti, dorso late purpureo-marginati. *Coronae* lobi intus appendiculati, 1–1·3 mm. longi, 1·5 mm. lati, 3-dentati, dente intermedio late deltoideo-ovato obtuso, dentibus lateralibus parvulis auriculato-inflexis; appendix prope apicem lobi inserta, filiformi-subulata, 0·5–0·75 mm. longa, supra antheras inflexa, basi in carinas duas decurrens.

Natal. Near Howick, 915–1220 m., *Wood*, 5385.

1063. **Schizoglossum decipiens**, *N. E. Br.* var. **flavum**, *N. E. Brown* [Asclepiadaceae]; a *S. decipiente*, N. E. Br., typico differt corolla viridiflava et coronae loborum corporibus in appendicibus confluentibus.

Natal. Niginya, 1520–1830 m., *Wylie in Herb. Wood*, 11206.

1064. **Sisyranthus Franksiae**, *N. E. Brown* [Asclepiadaceae]; affinis *S. compacto*, N. E. Br., sed caule duplo vel triplo longiore, foliis quam internodia brevioribus et coronae lobis supra antheras productis differt.

Caulis ad 0·75 m. altus, simplex, strictus, teres, glaber, internodiis 8–10 plerumque 10–12 cm. longis. *Folia* evoluta paribus 4–5, erecta, 3–9 cm. longa, 1–1·5 mm. lata, linearia, acuta, glabra, inferiora rudimentaria. *Umbellae* 3–4 ad apicem caulis in umbellam compositam 3 cm. diametro congestae. *Pedunculi* 0–1 cm. longi, parce patule pubescentes. *Pedicelli* 6–7 mm. longi, patule pubescentes. *Sepala* 2·5 mm. longa, lanceolata, acuminata, pubescentia. *Corolla* viridis, extra glabra; tubus 2–2·5 mm. longus,

intus ad faucem dense barbatus, infra glaber ; lobi 2 mm. longi, ovati, acuti, erecti, intus ubique pilis longis dense barbati. *Coronae* lobi 2 mm. longi, antheris multo longiores, late rhomboideo-ovati vel triangulari-ovati, subulato - acuminati, subula supra antheras inflexa, angulis lateralibus subacutis vel dentiformibus, glabri.

Natal. Near the mouth of the Matikulu River, *Wood*, 11208.

Named in honour of Miss Millicent Franks, the able assistant in the Natal Herbarium at Durban, who detected this as being a new species while making drawings of the dissections of all the Asclepiads in the Natal Herbarium for the use and benefit of future students. She has also prepared a large number of the plates published (under the initials M. F.) in Wood's *Natal Plants*.

1065. **Selago immersa**, *Rolfe* [Selagineae]; inter species floribus pedicellatis, pedicellis bracteis cuneatis adnatis et subimmersis distincta.

Fruticulus ramosissimus, 30 cm. longus vel ultra. *Ramuli* pubescentes, dense foliati. *Folia* fasciculata, cuneato-oblonga, acuta, apice incisa vel dentata, scabridula et ciliata, 3–4 mm. longa. *Spicae* numerosae, breves, densiflorae, circa 1 cm .longae. *Bracteae* cuneatae, subacutae, denticulatae, concavae, scabridulae, 3 mm. longae. *Pedicelli* bracteis omnino adnati et subimmersi, 1–1·5 mm. longi. *Calyx* campanulatus, 1 mm. longus, semi-5-fidus ; lobi oblongi, obtusi, ciliati. *Corolla* hypocrateriformis, alba ; tubus 3·5 mm. longus ; lobi orbiculari-elliptici, 2 mm. longi.

Natal. Giants Castle, 2400–3200 m., *Wylie in Herb. Wood*, 10665.

Remarkable for the complete union of the pedicel with the base of the broad concave bract, in which it appears to be immersed.

1066. **Stachys Cooperi**, *Skan* [Labiatae-Stachydeae]; affinis *S. grandifoliae*, E. Meyer, sed foliis parce molliter pubescentibus vel parcius hispidulis interdum infra fere glabratis, dentibus paucioribus (utrinque 12–15).

Caulis herbaceus, decumbens, tenuissimus, ramosus, 3–6 dm. longus, paulum molliter pubescens vel parce hispidulus ; rami ad 3 dm. longi vel ultra ; internodia 3–6 cm. raro ad 15 cm. longa. *Folia* petiolata, ovata, majora 4–5 cm. longa et 3–4 cm. lata, apice acuta vel obtusa, basi aperte profundeque cordata, regulariter crenata, parce et molliter pubescentia vel parcius hispidula, infra interdum fere glabrata, tenuissima : dentes saepe utrinque 12–15, 1–2 mm. alti, 3–5 mm. lati ; petioli gracillimi, 1–4 cm. longi. *Bracteae* breviter petiolatae vel subsessiles, inferiores ovatae, calyce longiores, superiores lineari-lanceolatae calyce breviores. *Verticillastri* pauci, 6-flori, paulum remoti. *Pedicelli* brevissimi. *Calyx* campanulatus, 6–8·5 mm. longus, sat dense et molliter pubescens vel parce hispidulus ; dentes lineari-triangulares, 2·5–4·5 mm. longi, basi 1–2 mm. lati, saepe conspicue patentes, interdum apice aceroso curvati. *Corolla* alba, pubescens, tubo anguste infundibuliformi 6–9 mm. longo incurvato ; labium posterius ellipticum, 5–6 mm. longum, integrum, dorso carinatum ; labium anterius

8–9 mm. longum, lobo intermedio suborbiculari vel obovato 3·5–6 mm. longo 4–8 mm. lato.

Cape Colony. Albany Division; without precise locality, *Cooper*, 15: Transkei; Kentani District, in forests at 365 m., *Miss Alice Pegler*, 908.

1067. **Stachys malacophylla**, *Skan* [Labiatae-Stachydeae]; species *S. sessilifoliae*, E. Meyer, proxima, sed foliis petiolatis, corolla multo majori, tubo longe exserto recedit.

Caulis herbaceus, decumbens, simplex vel parce ramosus, 2–4 dm. longus vel ultra, gracilis, dense griseo-velutinus; internodia 1·5–6 cm. longa. *Folia* petiolata, late ovata, 1–1·5 cm. longa et lata, apice rotundata, basi late cordata, crebre crenulata, dense vel densissime griseo-velutina; petioli 4–14 mm. longi. *Bracteae* breviter petiolatae vel subsessiles, inferiores foliis similes sed minores, superiores gradatim reductae. *Verticillastri* pauci vel sat multi, 2–6-flori, remoti. *Pedicelli* circiter 1·5 mm. longi. *Calyx* campanulatus, circiter 6 mm. longus, dense griseo-velutinus; dentes deltoideo-lanceolati, circiter 1·5 mm. longi, acuminati, paulum spinescentes. *Corolla* roseo-lilacina, pubescens, tubo 8 mm. longo calyce multo longiori; labium posterius ellipticum, 4 mm. longum, integrum, concavum; labium anterius 6–7·5 mm. longum, lobo intermedio suborbiculari 3 mm. longo circiter 4 mm. lato.

Cape Colony. Queenstown Division; Queenstown, 1220 m., *Galpin*, 1955: Hangklip Mountain, 1920–1980 m., *Galpin*, 5891.

Mr. Galpin describes the colour of the flowers as mauve. His specimen 5891 is much less densely grey-velutinous than the other cited.

1068. **Boerhaavia bracteata**, *T. Cooke* [Nyctaginaceae]; a *B. repente*, L., pilis horizontaliter patentibus, paniculae ramis fasciculatis et bracteis magnis differt.

Suffrutex erectus. *Caulis* teres, pilis horizontaliter patentibus villosus, infra lignosus. *Folia* late ovata, obtusa, petiolata, 3–7 cm. longa, 2–6 cm. lata, plus minusve nervis pilosa et margine ciliata, basi rotunda vel cordata: petioli inferiores longi, villosi. *Flores* laxe paniculati, paniculae ramis 2-fasciculatis, bractea magna pilosa et ciliata 6–12 mm. longa, ad ramorum originem instructi, uno ramo 2–3 flores sessiles apice gerente, altero ramo similiter diviso; bracteolae ovtao-lanceolatae, subacutae, membranaceae, nervo medio obscure brunneo conspicuo. *Perianthium* alabastro 3 mm. longum, parte inferiore 1 mm. longa, subglobosa, demum elongata. *Fructus* 3 mm. longus, oblongus, costatus, glandulosus.

South Africa. Avoca near Barberton, 570 m., *Galpin*, 1240; Bechuanaland, on the rocks at Chue Vley, *Burchell*, 2381; Port Natal, *Gerrard*, 1787.

There is also a small specimen in Harvey's Herbarium, Trinity College, Dublin, from Damaraland (Tropical Africa) without collector's name.

1069. **Cyrtanthus (Gastronema) Thorncroftii**, *C. H. Wright* [Amaryllidaceae-Amarylleae]; *C. unifloro*, Ker-Gawl., affinis, perianthio unicolore staminibusque non oblique insertis differt.

Bulbus subglobosus, 2 cm. diametro, in collum 3 cm. longum 7 mm. crassum productus, tunicis membranaceis brunneis vestitus. *Folia* duo, anguste oblanceolata, 15 cm. longa, 5 mm. lata, longe acuminata, parte superiore supra leviter sulcata, subtus carinata, parte inferiore plano-convexa, superficie superiore quam inferiore pallidiore. *Scapus* leviter compressus, 3 mm. diametro, viridis, 2-florus ; spathae submembranaceae, 3·5 cm. longae, basi 6 mm. latae, gradatim attenuatae ; pedicelli 2 cm. longi. *Perianthium* dilute carneum, non striatum ; tubus anguste infundibuliformis, 5 mm. longus, 2 mm. diametro ; limbus campanulatus, 2·5 cm. diametro ; lobi oblongo-lanceolati, exteriores apice callosi cucullatique, interiores plani acutioresque. *Stamina* in perianthii fauce inserta ; filamenta exteriora 2 mm. longa, interiora 4 mm. longa. *Ovarium* oblongum, trigonum, 5 mm. longum, 2·5 mm. diametro ; stylus 3 cm. longus, ramis linearibus recurvis 4 mm. longis instructus.

Transvaal. *Thorncroft.*

Described from a plant which flowered with Mr. W. E. Gumbleton at Belgrove, Queenstown, Ireland, in July, 1908.

1070. **Elionurus tenax**, *Stapf* [Gramineae - Andropogoneae] ; affinis *E. Pobeguinii*, Stapf, sed racemis ob pedunculos breves lateraliter e spatha exsertis, rhachis tenuioris tenacis articulis uti pedicellis dorso toto villosis, spiculis sessilibus paulo minoribus brevius bifidis, gluma inferiore dorso villosa distinctus.

Culmi ultra pedales, e partibus superioribus tantum noti, ramosi ; internodia superiora et rami superne pilosi. *Folia* superiora glabra ; vaginae laeves ; ligulae ad marginem breviter dense ciliatam redactae ; lamina e basi 2-3 mm. lata longe tenuissime attenuata, convoluta, superne ad costam et margines spinuloso - asperae. *Racemi* in ramis geminati, distantes, pedunculo brevi insidentes, e spatha 5–6 cm. longa lineari acuta superne late hyalina lateraliter exserti, densiflori, pilosi, albidi. *Rhacheos* tenacis articuli graciles, spicula duplo breviores, praeter faciem ubique albo-villosi. *Spiculae* sessiles cum callo brevi piloso 6 mm. longae, ovato-lanceolatae. *Gluma* inferior subchartacea, ad $\frac{1}{6}$–$\frac{1}{5}$ bifida, laciniis subulatis perinde ac carinis a basi rigide pectinato-ciliatis, dorso albopilosa, intra carinas tenuiter 5-nervis ; superior lanceolata, acuta, tenuiter 3-nervis, dorso minute pubescens. *Anthoecii* inferioris valva lanceolata, margine ciliolata, 3·5 mm. longa, obsolete 2-nervis, palea nulla. *Anthoecii* superioris valva paulo brevior, minute ciliolata, obsolete 3-nervis, caeterum valvae inferiori similis ; palea hyalina, minuta, 0·5 mm. longa. *Antherae* purpureae, 2 mm. longae. *Pedicelli* articulos subaequantes, graciles, dorso undique villosi. *Spiculae* pedicellatae 3·5–4 mm. longae, lanceolatae. *Gluma* inferior lanceolata, mucronato-acuminata, integra, sub altero margine anguste inflexo breviter ciliato stria balsamifera notata, altero angustissime inflexo vix ciliolato, dorso parce breviterque pubescens; reliqua fere ut in spiculis sessilibus, nisi flos masculus.

French Guinea. Kankan, *Bardou*, 15, 36.

LXI.—MALAYAN FERNS.

Col. R. H. Beddome.

The following notes on Ferns collected in the Malay Peninsula, from time to time, by Mr. H. N. Ridley, F.R.S., Director of the Botanic Gardens, Singapore, and transmitted by him to Kew, have been drawn up by Col. R. H. Beddome, F.L.S. ; a description of one new species is included.

Alsophila glauca, *J. Sm.* (Ridley, 7868). This is less glaucous than the typical form, and the rhachis of the frond, as well as the stipe, is strongly armed with red prickles.

Alsophila dubia, *Bedd.* (Ridley, 7869 and 12534). More copious specimens of this tree fern prove that it is not specifically distinct from *A. commutata*, Mett., which is very variable and includes narrow and broad pinnuled forms with intermediate ones.

Alsophila ornata, *J. Scott* (Ridley, 6551 and 7151). These exactly correspond to the Indian examples of *A. ornata*. Mr. Ridley has sent a very large series of specimens of *A. latebrosa*, Wall., from various parts of the Malay Peninsula, which represent different stages between the type (which has the lobes of the pinnules only 1 cm. long and scarcely or very inconspicuously crenate), and *A. crenata*, J. Scott (which has the lobes 2·2 cm. long and conspicuously crenate). *A. ornata* must therefore be dropped as a species, but may be kept up as an extreme form under the name of **A. latebrosa, var. ornata**, Bedd.

Cibotium glaucum, *Hook. et Arn.* (Ridley, 9532). This has not been recorded previously from the Malay Peninsula, but exactly corresponds with Sandwich Island specimens. It differs from *C. Barometz*, J. Sm., in its involucre and venation.

Microlepia Speluncae, var. **hirta**, *Bedd.* (Ridley, 7138). A form from Pulau Penang with the pinnules more deeply cut than usual.

Hypolepis punctata, *Bedd.* (Ridley, 7867). Suppl. Ferns Brit. Ind. p. 19. Ridley's specimens have a prominent involucre.

Pteris quadriaurita, var. **hamulosa**, *Bedd.* (*P. hamulosa*, Wall.) (Ridley, 6946). Collected in Johor.

Asplenium tenuifolium, *Don* (Ridley, 14001). Collected at Padang and with fronds much less cut than in the Indian forms.

Diplazium tomentosum, *Bl.* (Ridley, 11428). Collected in Perak. The pinnules are much more deeply cut than in the type; there are, however, intermediate forms in the Kew Herbarium.

Lastrea Ridleyi, *Bedd.* ; species *Nephrodio* (*Lastreae*) *Thelypteri*, var. *squamuloso*, Hook., affinis, rhizomate erecto pinnisque angustis recedit.

Rhizoma erectum. *Stipites* caespitosi, rigidi, erecti, obscure rufo-brunnei, 9 cm. longi, puberuli, squamis lanceolatis longe acuminatis (praesertim basi) instructi. *Frondes* circa 15 cm. longae et 5 cm. latae, anguste oblongae, parte inferiore pinnata, apice pinnatifida, siccitate fere atrae ; pinnae 18–20-jugae, alternae vel inferiores

suboppositae, coriaceae, 2 cm. longae, 8 mm. latae, fere ad rhachidem in lobos oblongos obtusos leviter crenatos minute ciliatos divisae, loborum paria 3–4 infima deflexa mediis minora ; venae semper indivisae. *Sori* 1–3 ad quosque lobos, ad mediam venarum affixi ; indusium non visum.

Malay Peninsula. Selangor : Bukit Hetam, *H. N. Ridley*, 7849.

The sori are over ripe and show no trace of an indusium, which if constantly absent would cause this plant to be placed in *Phegopteris*.

Lastrea cana, *J. Sm.* (Ridley, 7859). Collected at Selangor.

Nephrodium moulmeinense, *Bedd.* (Ridley, 10972). Collected in Johor.

Nephrodium molle, *R. Br.* (Ridley, 6963.) A form with very narrow pinnules collected at Parmatang Bartan, similar to No. 3212 of a former collection from Gunong.

Nephrodium molle, var. **major**, *Bedd.* (*N. Papilio*, Hope) (Ridley, 7853). There are many forms intermediate between this and the type.

Polypodium subevenosum, *Baker* (Ridley, 7134 and 10172). Collected in Pulau Penang.

Polypodium minimum, *Baker* (Ridley, 12136). Collected in Johor, only recorded previously from Borneo.

Polypodium subpinnatifidum, *Bl.* (Ridley, 12035). Collected in Pulau Penang.

Goniophlebium amoenum, *J. Sm.* (Ridley, 12033). A form collected in Selangor differing from those hitherto known only in its smaller size.

LXII.—MISCELLANEOUS NOTES.

Mr. T. F. Chipp, who entered the service of Kew as a young gardener on April 2nd, 1906, and thereafter was employed, from September 17th, 1906, to October 10th, 1908, as a temporary Technical Assistant in the Herbarium, has successfully passed the B.Sc. examination in the University of London, with honours in Botany. We understand that he has been appointed Demonstrator in Botany at the Birkbeck Institute.

Dr. Maurits Greshoff.—With much regret we have to record the sudden death of Dr. M. Greshoff, Director of the Koloniaal Museum, Haarlem, during the night of December 7–8. Dr. Greshoff was the son of a medical practitioner, and studied at the University of Utrecht and afterwards at Jena. On taking his degree he entered the medical service of the Dutch East Indian Army and was sent to the Botanic Gardens, Buitenzorg, where from 1888–1892 he carried on an investigation of Indian poisonous plants. His results were published in two volumes in "Mededeelingen uit 's Lands Plantentuin." Owing to a breakdown in health, in 1892, he returned to Holland, and a few years later was

appointed Chemist to the Koloniaal Museum, Haarlem, and, on the death of the Director, he succeeded to that office and continued his work on Indian products.

When at Buitenzorg he became associated with Dr. M. Treub, late Director of the Botanic Gardens, in the study of hydrocyanic acid in *Pangium edule*, and afterwards paid much attention to cyanogenesis in plants, and also to the presence of alkaloids, holding the view that the presence of these substances could be utilised as characters in the classification of plants.

Dr. Greshoff worked at Kew in 1898 and paid a short visit in September, 1908. During the past summer he spent about three weeks here working in the Jodrell Laboratory.

On the occasion of his last visit he was, as always, an indefatigable worker, and examined material from every department of the Gardens in the prosecution of his researches. The paper in this number of the *Bulletin* which embodies some of the results of his work at Kew was meant to be the first part of a general systematic survey of those plants which contain hydrocyanic acid, alkaloids, &c. The proofs of the paper reached us on the same day as the sad news of his death at the early age of 47.

Sir Alfred Jones, K.C.M.G.—The death of Sir Alfred Jones, on 13 December, 1909, at the comparatively early age of 62, has deprived Kew of a friend who took a deep and helpful interest in the economic work of the institution and in its policy of establishing Botanic Stations in the West African Colonies. His successful efforts in developing the trade and in creating a market for tropical fruits—more especially bananas—in this country are now a matter of history. More recently his energies were directed to fostering the cultivation of cotton within British possessions. Among his other attempts to ensure the application of scientific knowledge to affairs may be mentioned his support of preventive medical measures undertaken in order to improve the amenities of life under tropical conditions.

Quinoa or Quinua (*Chenopodium Quinoa*).—From time to time samples of the seeds of this plant have been received at Kew for determination, and a short time ago a series of specimens collected by the Assistant Director on the shores of Lake Titicaca, Bolivia, at an elevation of 3800–4000 m., were added to the Museum Collection. In Monthly Consular and Trade Reports, No. 344 (U.S.A.), for May 1909, it is stated that "Americans are seeking information with regard to the 'quinua' grain of the Andes Mountains with the view to its possible importation into the United States. The plant grows at a high altitude and supplies cereal food in regions where other grain and potatoes will not thrive. Consul-General Herman R. Dietrich, of Guayaquil, furnishes the following information concerning its growth and use in Ecuador:—In this country quinua is cultivated to some extent in the valleys of the Andes, where the climate is cool, and at an elevation of 6,000 to 9,000 feet. There are two classes, called 'yellow quinua,' and 'white

quinua,' which are marketed at the same price. In the Yaruqui Valley, near Quito, it appears to be most abundant, and it is reported that 100 tons may be obtained there yearly. It is said that about 20,000 pounds of this article may be bought in Quito monthly, and that by offering a small advance in price, a much larger quantity could be obtained in the provinces of Pichincha and Imbabura, which are situated in the inter-Andean Valleys.

"It is seldom that there is a failure of the quinua crop. This only occurs once in a number of years, when there is great scarcity of rain. The quinua when harvested and dried, and then stored in a perfectly dry place, will keep for about one year, after which it will lose more or less of its flavour. During the time it is kept in this dry state it retains its bitter qualities, for which reason it is not subject to the attack of insects as it would otherwise be. It is stated that the Indians hang the plant outside of their houses in the same manner as they do tobacco and bananas, but rarely keep it in this state longer than three months, although if kept thoroughly dry it can be kept as long as six months.

"The quinua is washed before cooking, which may be done by machinery, for the reason that the washing takes away a portion of the bitter element which it contains."

As an article of food quinoa is principally used by the Indians or the labouring classes, who earn very small wages. By these it is cooked in an open pot and frequently in sufficient quantity to last the family for some time. In its cooked state it is again allowed to dry, and it is then an easy matter to preserve it for some weeks. The dishes prepared from it are soups; cakes with brown sugar added to them, called "panela"; and a drink called "chicha de quinua," made from a mixture of quinoa and corn or barley.

Teodoro Wolf states in his Geography and Geology of Ecuador, which was published in 1892, that corn and quinoa were the principal articles of food of the ancient Indians, and that the raising of the latter was more extensively engaged in by them than by the present inhabitants, on account of the recent introduction and development of other cereals.

"The price usually paid for quinua in this country is from $3 to $5 United States currency per quintal of 46 kilos (101 pounds). The bulk of this article is marketed from June to October. As to the cost of shipping this product to San Francisco or New York, it may be stated that the freight rate from Quito to Panama is about $3 United States currency per quintal, with an additional expense of about 50 cents per quintal for packing."

Quoting from Prof. A. H. Church in "Food Grains of India," the plant was introduced some years ago into that country from Peru, but so far as can be gathered its introduction does not appear to have been a success.

According to this writer a light argillaceous soil or loam is suitable for the growth of the plant. It may be sown in furrows or on ridges a yard apart, the plants in the rows being singled so as to leave two feet between each; but it yields heavier heads of grain when sown in nurseries and then transplanted to the fields. The harvest takes place seven months after seed-time. It is a hardy plant, which may be grown successfully in countries and climates

and at elevations above the sea such as are suited to the barley crop.

The following analysis was made, by the late Dr. A. Voelcker, of the bitter variety of quinoa seed, which variety appears to differ from the ordinary sort only in the presence of a small quantity of a bitter and acrid substance :—

	In 100 parts.	In 1 lb.
Water	16·0	2 ozs. 245 grs.
Albuminoids ...	19·2	3 „ 32 „
Starch, &c. ...	47·8	7 „ 283 „
Oil	4·8	0 „ 336 „
Fibre	8·0	1 „ 122 „
Ash	4·2	0 „ 294 „

Quinoa seeds should be soaked for a short time in water and boiled quickly therein; this water should then be thoroughly drained away on a sieve or colander, and the cooking finally completed in another portion of fresh water. Under this treatment the bitter principle present in one of the chief varieties of this seed is removed.

Quinoa seeds are extremely small; 15,000 do not weigh more than an ounce.

J. M. H.

Longevity of Fern-spores.—An illustration of this has occurred in the case of *Cheilanthes mysurensis*, Wall., specimens of which were collected in South China on the 28th of October, 1899, and preserved as herbarium specimens. Spores taken from these and sown at Kew in March, 1908, have produced healthy plants, which now bear fully developed fronds about 9 inches long. The species grows in dry rocky places at low elevations, and is distributed from Japan, Formosa and Central China to Tonkin, Southern India and Ceylon. When the fronds are dried without much pressure, their margins incurve greatly and serve as an additional protection to the spores.

C. H. W.

The Useful Plants of Nigeria.—Under this title an account of Nigerian plants of economic importance is being prepared by Mr. J. H. Holland, Assistant in the Museums, Royal Botanic Gardens, Kew. The first instalment of this work has recently been published as *Kew Bulletin; Additional Series IX., Part I.* This part contains 176 pages, with an outline map of Nigeria and plans of the Botanic Station, Olokemeji, of the Botanic Gardens, Old Calabar, and of the Onitsha Plantations, Southern Nigeria. There is also a chart shewing the exportation of mahogany for the period of years 1894–1907. The introductory portion occupies the first 47 pages of this part, and gives a short account of Southern and Northern Nigeria, followed by some general remarks on the botany of the region, with notes as to the collection of specimens; a list of botanical collectors and a historical account of the various botanic stations. The progress of agriculture and forestry are also reviewed.

The useful plants of the various natural orders are then dealt with seriatim, and in every case references to the most important illustrations of the various plants mentioned are given, and the literature is cited under each species. Where possible the vernacular names of the plants are added. The arrangement of the systematic portion follows that of the *Flora of Tropical Africa.*

In this first instalment the orders *Ranunculaceae* to *Anacardiaceae* are dealt with, and the account of *Anacardium occidentale* completes the part.

In addition to the general information on the economic importance of the various species dealt with, notes are given as to methods of cultivation and propagation.

A preface and an index to the work will be issued with the concluding part.

Botanical Magazine for December.—*Parthenocissus tricuspidata*, Planch., is the favourite climber better known as *Ampelopsis Veitchii*, Hort., or *Vitis inconstans*, Miq., which, in consequence of an article in one of the daily papers, has been frequently confused with the Poison Ivy, *Rhus Toxicodendron.* The *Parthenocissus* is a harmless plant, usually having simple leaves, whereas in the Poison Ivy the leaves are never simple. A native of Japan and China, it was brought into general cultivation in 1868 by Messrs. J. Veitch & Sons. The South African *Asparagus tetragonus*, Bresler, has been grown at Kew for many years past. It is a climbing under-shrub with linear cladodes and rather dense racemes of white, very fragrant flowers. *Prunus maritima*, Wangenh., is the Shore Plum of Eastern North America. It is a low-growing shrub with white flowers and red-purple, usually ellipsoid, fruits nearly 1 in. long. It flowers in May at Kew, where it has long been in cultivation. *Opuntia imbricata*, DC., is a native of Mexico and the South-Western United States, and has been figured from a specimen collected in Colorado in 1878 by Sir E. G. Loder, Bart., in whose garden at Leonardslee, Horsham, it flowered in August, 1908. It belongs to a small group of Opuntias which have cylindric stems with short ridge-like compressed tubercles and closely sheath-clad spines. Though first introduced to cultivation about a century ago, and the best known of its group in European gardens, its bright purple flowers are rarely seen in this country. *Euryops virgineus*, Less., is a small South African shrub belonging to the Compositae. It has very small 3-5-lobed leaves and solitary, axillary, rather small flower-heads on peduncles about 1 in. long. The figure was prepared from material sent to Kew by Mr. T. A. Dorrien Smith, of Tresco Abbey, Isles of Scilly.

The present volume of the Magazine (vol. 135) is dedicated to Mr. F. W. Moore, M.A., A.L.S., V.M.H., Keeper of the Royal Botanic Garden, Glasnevin, Dublin.

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